Tunnel emission from Co and Cr-related levels in p-type Ge

S. Segers,[a] J. Lauwaert,[a] P. Clauws,[a] E. Simoen,[b] J. Vanhellemont,[a] F. Callens[a] and H. Vrielinck[a]

[1] Ghent University, Department of Solid State Sciences, Krijgslaan 281-S1, B-9000 Gent, Belgium
[2] Imec, Kapeldreef 75, B-3010 Leuven, Belgium.

Henk.Vrielinck@UGent.be

Keywords: germanium, DLTS, transition metal, tunnel emission

Ge is used in advanced electronic devices for its high electron and hole drift mobility [1]. Germanides are used as contacting layers in devices, but even as trace impurities the associated metals can have a severe impact on the electronic properties of the Ge device layer. Understanding the interaction between free carriers and these metal related defects is very important. A comprehensive DLTS study of 3d transition metal impurities in Ge has been conducted in the past few years [2] and defect levels have been well characterized and assigned. In this work we focus on a particular feature observed in DLTS spectra of Co and Cr in p-Ge. Besides thermal carrier emission, a second, slower and temperature independent emission component is present. Its effect on the DLTS spectra is similar to that of direct tunneling from quantum wells and dots [3], although there are remarkable differences. This tunneling is already observed at low electric fields and is only weakly dependent on the field strength. If tunneling is observed in more than one spectral component, DLTS allows establishing whether or not the corresponding trap levels are due to the same defect.

[1] C. Claeys, E. Simoen “Germanium-based technologies” (2007)
[2] Lauwaert et al., J. Appl. Phys. 111, 113713 (2012)
[3] S. Schulz et al., Phys. Rev. B 69, 195317 (2004)